



EFFECT OF 1% TTBLs ON INDUSTRIAL PASTE AND PLATE CURING — 1ST SAMPLE

| CONTROL SAMPLES | | | | | |
|---|-------|---------------|---------------|------------|----------|
| SAMPLE | TRIAL | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | 1 | 58.0 | 2.6 | 0.0 | 39.4 |
| | 2 | 51.1 | 7.9 | 0.0 | 40.9 |
| | 3 | 59.4 | 2.2 | 1.2 | 37.2 |
| | 4 | 66.4 | 2.1 | 0.0 | 31.5 |
| | 5 | 50.2 | 1.1 | 2.4 | 46.3 |
| | AVG | 57.0 | 3.2 | 0.7 | 39.1 |
| PASTE PLATE AT END OF TUNNEL DRYER | 1 | 66.7 | 1.9 | 0.0 | 31.4 |
| | 2 | 59.2 | 8.5 | 5.7 | 26.6 |
| | 3 | 55.9 | 5.5 | 10.6 | 28.1 |
| | 4 | 61.8 | 4.8 | 2.1 | 31.3 |
| | 5 | 60.8 | 3.2 | 6.9 | 29.1 |
| | AVG | 60.9 | 4.8 | 5.1 | 29.3 |
| PLATES AFTER 3 HOURS CURING | 1 | 57.5 | 9.7 | 0.5 | 32.3 |
| | 2 | 61.2 | 10.7 | 0.0 | 28.8 |
| | 3 | 60.7 | 8.7 | 2.1 | 28.5 |
| | 4 | 60.4 | 9.8 | 1.0 | 28.7 |
| | 5 | 58.7 | 5.3 | 2.9 | 33.1 |
| | AVG | 59.7 | 8.8 | 1.3 | 30.3 |
| PLATES AFTER 6 HOURS CURING | 1 | 52.0 | 4.4 | 1.8 | 41.8 |
| | 2 | 57.1 | 9.1 | 0.0 | 33.7 |
| | 3 | 59.6 | 2.4 | 0.9 | 37.1 |
| | 4 | 54.4 | 8.2 | 1.6 | 35.8 |
| | 5 | 57.2 | 7.5 | 2.7 | 32.6 |
| | AVG | 56.1 | 6.3 | 1.4 | 36.2 |
| PLATES AFTER 9 HOURS CURING | 1 | 52.6 | 4.3 | 1.5 | 41.6 |
| | 2 | 67.7 | 2.3 | 1.9 | 28.2 |
| | 3 | 63.6 | 6.9 | 1.9 | 27.6 |
| | 4 | 60.2 | 10.4 | 2.3 | 27.2 |
| | 5 | 61.6 | 3.2 | 1.9 | 33.3 |
| | AVG | 61.1 | 5.4 | 1.9 | 31.6 |
| PLATES AFTER 12/13 HOURS CURING | 1 | 30.2 | 1.7 | 68.1 | 0.0 |
| | 2 | 59.1 | 10.3 | 4.6 | 26.0 |
| | 3 | 59.8 | 2.1 | 14.2 | 23.9 |
| | 4 | 64.9 | 2.3 | 11.0 | 21.8 |
| | 5 | 53.9 | 4.3 | 9.3 | 32.4 |
| | AVG | 53.6 | 4.8 | 21.4 | 26.0 |

FIG. 2B

EFFECT OF 1% TTBLs ON INDUSTRIAL PASTE AND PLATE CURING — 1ST SAMPLE

| EXPERIMENTAL SAMPLES | | | | | |
|---|-------|---------------|---------------|------------|----------|
| SAMPLE | TRIAL | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | 1 | 38.5 | 0.0 | 51.7 | 9.8 |
| | 2 | 34.1 | 0.7 | 57.7 | 7.5 |
| | 3 | 36.1 | 0.0 | 58.3 | 5.5 |
| | 4 | 40.2 | 0.0 | 55.1 | 4.7 |
| | 5 | 34.5 | 1.2 | 59.5 | 4.8 |
| | AVG | 36.7 | 0.4 | 56.5 | 6.5 |
| PASTE PLATE AT END OF TUNNEL DRYER | 1 | 81.9 | 8.1 | 10.1 | 0.0 |
| | 2 | 45.2 | 2.1 | 27.4 | 25.3 |
| | 3 | 44.1 | 1.6 | 29.9 | 23.9 |
| | 4 | 43.8 | 1.2 | 43.0 | 11.9 |
| | 5 | 48.6 | 3.4 | 19.5 | 28.5 |
| | AVG | 52.7 | 3.3 | 26.0 | 17.9 |
| PLATES AFTER 3 HOURS CURING | 1 | 26.2 | 2.2 | 71.6 | 0.0 |
| | 2 | 20.8 | 4.3 | 71.5 | 3.4 |
| | 3 | 34.6 | 3.4 | 57.4 | 4.6 |
| | 4 | 24.1 | 3.4 | 66.7 | 5.8 |
| | 5 | 36.9 | 1.9 | 51.3 | 10.0 |
| | AVG | 28.5 | 3.0 | 63.7 | 4.8 |
| PLATES AFTER 6 HOURS CURING | 1 | 25.3 | 2.9 | 71.8 | 0.0 |
| | 2 | 19.4 | 5.5 | 72.6 | 2.5 |
| | 3 | 31.0 | 2.0 | 67.0 | 0.0 |
| | 4 | 28.1 | 1.4 | 66.8 | 3.6 |
| | 5 | 32.6 | 1.7 | 65.6 | 0.0 |
| | AVG | 27.3 | 2.7 | 68.8 | 1.2 |
| PLATES AFTER 9 HOURS CURING | 1 | 26.7 | 4.5 | 61.7 | 7.0 |
| | 2 | 27.3 | 1.5 | 67.9 | 3.4 |
| | 3 | 31.0 | 1.8 | 67.2 | 0.0 |
| | 4 | 30.2 | 0.8 | 69.0 | 0.0 |
| | 5 | 29.0 | 1.6 | 65.8 | 3.5 |
| | AVG | 28.8 | 2.0 | 66.3 | 2.8 |
| PLATES AFTER 12/13 HOURS CURING | 1 | 29.5 | 1.0 | 69.5 | 0.0 |
| | 2 | 18.9 | 2.5 | 75.3 | 3.3 |
| | 3 | 32.5 | 1.5 | 65.9 | 0.0 |
| | 4 | 28.8 | 0.7 | 67.1 | 3.3 |
| | 5 | 30.9 | 1.0 | 68.1 | 0.0 |
| | AVG | 28.1 | 1.3 | 69.2 | 1.3 |

FIG. 3A

EFFECT OF 1% TTBLs ON INDUSTRIAL PASTE AND PLATE CURING — 2ND SAMPLE

| CONTROL SAMPLE | | | | | | |
|-------------------------------|------------|------|---------------|---------------|------------|----------|
| SAMPLE | SAMPLE NO. | PB | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | | 13.8 | 25.8 | 5.1 | 5.1 | 50.3 |
| | AVG | 13.8 | 25.8 | 5.1 | 5.1 | 50.3 |
| PASTED PLATE AT END OF TUNNEL | | 15.6 | 28.2 | 2.4 | 10.6 | 43.3 |
| | AVG | 15.6 | 28.2 | 2.4 | 10.6 | 43.3 |
| FULL RACK IN CHAMBER | | 16.5 | 28.5 | 13.8 | 0.0 | 41.2 |
| | AVG | 16.5 | 28.5 | 13.8 | 0.0 | 41.2 |
| AFTER 2 HOURS IN CHAMBER | | 17.1 | 27.7 | 8.0 | 2.8 | 44.4 |
| | AVG | 17.1 | 27.7 | 8.0 | 2.8 | 44.4 |
| AFTER 4 HOURS IN CHAMBER | | 14.6 | 22.6 | 3.1 | 16.2 | 43.5 |
| | AVG | 14.6 | 22.6 | 3.1 | 16.2 | 43.5 |
| AFTER 6.5 HOURS IN CHAMBER | | 17.2 | 24.8 | 2.4 | 14.9 | 40.7 |
| | AVG | 17.2 | 24.8 | 2.4 | 14.9 | 40.7 |
| AFTER 8.6 HOURS IN CHAMBER | | 18.6 | 19.8 | 16.1 | 3.3 | 42.2 |
| | AVG | 18.6 | 19.8 | 16.1 | 3.3 | 42.2 |
| AFTER 12.5 HOURS IN CHAMBER | | 12.0 | 17.5 | 4 | 29 | 37.4 |
| | AVG | 12.0 | 17.5 | 4 | 29 | 37.4 |
| AFTER 16.5 HOURS IN CHAMBER | | 3.2 | 14.5 | 1.1 | 59.6 | 21.6 |
| | AVG | 3.2 | 14.5 | 1.1 | 59.6 | 21.6 |
| AFTER 20.5 HOURS IN CHAMBER | | 4.7 | 25 | 14.85 | 43.5 | 25.1 |
| | | 0 | 15 | 1.1 | 75.3 | 8.6 |
| | AVG | 2.35 | 20 | 7.975 | 59.4 | 16.85 |
| AFTER 24.5 HOURS IN CHAMBER | | 0 | 15 | 1.1 | 75.3 | 8.6 |
| | AVG | 0 | 15 | 1.1 | 75.3 | 8.6 |
| AFTER 28.5 HOURS IN CHAMBER | | 0 | 15.4 | 1.3 | 76.8 | 6.6 |
| | AVG | 0 | 15.4 | 1.3 | 76.8 | 6.6 |

FIG. 3B

EFFECT OF 1% TTBLs ON INDUSTRIAL PASTE AND PLATE CURING — 2ND SAMPLE

| EXPERIMENTAL SAMPLES | | | | | | |
|-------------------------------|------------|-------|---------------|---------------|------------|----------|
| SAMPLE | SAMPLE NO. | PB | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | | 11.4 | 10.9 | 2.7 | 53.2 | 21.9 |
| | | 17.8 | 6.7 | 0.8 | 69.1 | 5.6 |
| | | 18.7 | 6.3 | 0.0 | 50.0 | 25.0 |
| | AVG | 15.97 | 8.0 | 1.2 | 57.4 | 17.5 |
| PASTED PLATE AT END OF TUNNEL | | 8.2 | 13.0 | 3.2 | 54.7 | 20.9 |
| | | 16.6 | 8.6 | 0.9 | 57.3 | 16.6 |
| | | 19.8 | 4.7 | 0.0 | 67.4 | 8.1 |
| | AVG | 14.87 | 8.8 | 1.4 | 59.8 | 15.2 |
| FULL RACK IN CHAMBER | | 8.2 | 13.5 | 0.9 | 62.3 | 15.2 |
| | | 18.4 | 6.0 | 0.4 | 56.1 | 19.1 |
| | | 18.3 | 9.2 | 0.8 | 66.2 | 5.5 |
| | AVG | 14.97 | 9.6 | 0.7 | 61.5 | 13.3 |
| AFTER 2 HOURS IN CHAMBER | | 9 | 12.8 | 1.1 | 77.1 | 0.0 |
| | | 12.6 | 5.7 | 2.7 | 70.6 | 8.5 |
| | | 19.2 | 5.8 | 1.3 | 64.7 | 9.0 |
| | AVG | 13.60 | 8.1 | 1.7 | 70.8 | 5.8 |
| AFTER 4 HOURS IN CHAMBER | | 7.3 | 6.9 | 1.0 | 73.0 | 11.8 |
| | | 12.2 | 4.4 | 1.4 | 68.2 | 13.9 |
| | | 6.5 | 9.6 | 1.0 | 75.5 | 7.4 |
| | AVG | 8.67 | 7.0 | 1.1 | 72.2 | 11.0 |
| AFTER 6 HOURS IN CHAMBER | | 7.8 | 10.5 | 1.1 | 80.2 | 0.3 |
| | | 11.9 | 2.7 | 1.4 | 70.0 | 14.0 |
| | | 7.3 | 3.9 | 2.0 | 74.1 | 12.7 |
| | AVG | 9 | 5.7 | 1.5 | 74.8 | 9.0 |
| AFTER 8 HOURS IN CHAMBER | | 6.4 | 5.2 | 1.6 | 73 | 13.8 |
| | | 9.4 | 7.9 | 1.6 | 72.4 | 8.7 |
| | AVG | 7.9 | 6.55 | 1.6 | 72.7 | 11.25 |
| AFTER 10 HOURS IN CHAMBER | | 2.4 | 5.9 | 2.2 | 80 | 9.5 |
| | AVG | 2.4 | 5.9 | 2.2 | 80 | 9.5 |
| AFTER 12 HOURS IN CHAMBER | | 1.9 | 3.4 | 2.4 | 83.7 | 8.5 |
| | | 1.7 | 10.5 | 1.7 | 80.3 | 5.8 |
| | AVG | 1.8 | 6.95 | 2.05 | 82 | 7.15 |
| AFTER 14 HOURS IN CHAMBER | | 7.4 | 8.4 | 1.2 | 72.4 | 10.6 |
| | AVG | 7.4 | 8.4 | 1.2 | 72.4 | 10.6 |
| AFTER 16 HOURS IN CHAMBER | | 1.2 | 5.6 | 2 | 83.4 | 7.7 |
| | | 13.1 | 8.4 | 1.3 | 72.4 | 4.8 |
| | AVG | 7.15 | 7.00 | 1.65 | 77.90 | 6.25 |
| AFTER 18 HOURS IN CHAMBER | | 1.3 | 4.4 | 3.3 | 83.7 | 7.3 |
| | | 0 | 7.2 | 0 | 86.5 | 6.4 |
| | AVG | 0.65 | 5.8 | 1.65 | 85.1 | 6.85 |
| AFTER 20 HOURS IN CHAMBER | | 1.7 | 6.9 | 2.3 | 81.1 | 7.9 |
| | | 0.8 | 10.8 | 1.9 | 86.5 | 0 |
| | AVG | 1.05 | 7.83 | 1.95 | 84.23 | 4.92 |
| AFTER 22 HOURS IN CHAMBER | | 1.3 | 4.4 | 3.3 | 83.7 | 7.3 |
| | AVG | 1.3 | 4.4 | 3.3 | 83.7 | 7.3 |
| AFTER 24 HOURS IN CHAMBER | | 1.5 | 11.8 | 2.3 | 84.5 | 0 |
| | | 1.3 | 8.7 | 2.4 | 80.3 | 7.3 |
| | AVG | 1.4 | 10.25 | 2.35 | 82.4 | 3.65 |
| AFTER 26 HOURS IN CHAMBER | | 0.7 | 6.4 | 2.1 | 89.7 | 1.1 |
| | AVG | 0.7 | 6.4 | 2.1 | 89.7 | 1.1 |
| AFTER 28 HOURS IN CHAMBER | | 0.6 | 11.5 | 1.9 | 86 | 0 |
| | | 1.1 | 6 | 2.4 | 89.2 | 1.4 |
| | AVG | 0.85 | 8.75 | 2.15 | 87.6 | 0.7 |

FIG. 6A EFFECT OF 1% TTBLs ON AUTOMOTIVE PASTE AND PLATE CURING — THIRD SAMPLE

| CONTROL SAMPLE | | | | | | |
|--|-------|-------|------------------|------------------|------------|----------|
| SAMPLE | TRIAL | PB | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | 41 | 9.3 | 62.3 | 0.0 | 0.0 | 26.6 |
| | 40 | 3.1 | 72.5 | 1.4 | 0.0 | 23.1 |
| | AVG | 6.2 | 67.4 | 0.7 | 0.0 | 24.9 |
| PASTED PLATE AT END OF TUNNEL DRYER | 37 | 5.4 | 60.4 | 0.0 | 0.0 | 34.2 |
| | 38 | 18.7 | 49.3 | 0.7 | 0.0 | 31.3 |
| | 39 | 10.8 | 58.3 | 0.5 | 0.0 | 30.4 |
| | AVG | 11.63 | 56.0 | 0.4 | 0.0 | 32.0 |
| TWO HOURS AFTER LOADING CURING CHAMBER | | | | | | |
| | AVG | | | | | |
| SIX HOURS AFTER LOADING CURING CHAMBER | 1 | | 52.0 | 4.4 | 1.8 | 41.8 |
| | 2 | | 57.1 | 9.1 | 0.0 | 33.7 |
| | 3 | | 59.6 | 2.4 | 0.9 | 37.1 |
| | 4 | | 54.4 | 8.2 | 1.6 | 35.8 |
| | 5 | | 57.2 | 7.5 | 2.7 | 32.6 |
| | AVG | | 56.1 | 6.3 | 1.4 | 36.2 |
| 8 HOURS AFTER LOADING CURING CHAMBER | 12 | 7 | 63.1 | 1.0 | 0.0 | 28.8 |
| | 17 | 8.3 | 60.5 | 5.5 | 0.0 | 26.1 |
| | 18 | 6.8 | 59.1 | 5.1 | 0.0 | 28.9 |
| | 4 | | 60.2 | 10.4 | 2.3 | 27.2 |
| | 5 | | 61.6 | 3.2 | 1.9 | 33.3 |
| | AVG | 7.4 | 60.9 | 5.0 | 0.8 | 28.9 |
| 18 HOURS AFTER LOADING CURING CHAMBER | 21 | 8.1 | 57.9 | 2.8 | 7.3 | 24.0 |
| | 23 | 7.5 | 58.2 | 3.6 | 7.9 | 24.0 |
| | 24 | 7.7 | 67.7 | 0.0 | 0.0 | 24.6 |
| | AVG | 7.8 | 63.0 | 1.8 | 4.0 | 24.3 |
| 24 HOURS AFTER LOADING CURING CHAMBER | 29 | 5.1 | 44.4 | 0 | 35.7 | 14.8 |
| | 30 | 2.5 | 62.6 | 1 | 12.1 | 21.8 |
| | AVG | 3.8 | 53.5 | 0.5 | 23.9 | 18.3 |
| END OF CURE | 31 | 0 | 53.2 | 0.3 | 31.96 | 14.7 |
| | 32 | 0.8 | 50.7 | 0 | 36.2 | 12.3 |
| | AVG | 0.4 | 51.95 | 0.15 | 34.05 | 13.5 |

FIG. 6B EFFECT OF 1% TTBLs ON AUTOMOTIVE PASTE AND PLATE CURING — THIRD SAMPLE

| EXPERIMENTAL SAMPLE | | | | | | |
|--|-------|-------|------------------|------------------|------------|----------|
| SAMPLE | TRIAL | PB | A-PBO (TETRA) | B-PBO (ORTHO) | TETRABASIC | TRIBASIC |
| PASTE AT END OF MIXING | 1 | 6.7 | 51.0 | 0.0 | 19.8 | 23.1 |
| | 2 | 14.9 | 48.3 | 0.9 | 12.2 | 23.7 |
| | AVG | 10.8 | 49.7 | 0.5 | 16.0 | 23.4 |
| PASTED PLATE AT END OF TUNNEL DRYER | 3 | 10.3 | 49.3 | 0.5 | 14.3 | 25.8 |
| | 4 | 8 | 47.7 | 4.1 | 15.9 | 24.3 |
| | 5 | 17.2 | 43.0 | 0.6 | 14.3 | 24.9 |
| | 42 | 13.8 | | 1.2 | 21.4 | 22.1 |
| | AVG | 12.3 | 46.7 | 1.6 | 16.5 | 24.3 |
| TWO HOURS AFTER LOADING CURING CHAMBER | 6 | 12.9 | 43.3 | 0.6 | 21.8 | 21.3 |
| | 7 | 14.4 | 44.3 | 4.8 | 17.8 | 19.1 |
| | 8 | 12.3 | 49.2 | 1.4 | 18.4 | 18.8 |
| | 9 | 10.2 | 45.3 | 0.4 | 24.1 | 20.1 |
| | AVG | 12.4 | 45.5 | 1.8 | 20.5 | 19.8 |
| SIX HOURS AFTER LOADING CURING CHAMBER | 10 | 4.4 | 25.2 | 4.4 | 60.7 | 5.3 |
| | AVG | 4.4 | 25.2 | 4.4 | 60.7 | 5.3 |
| 8 HOURS AFTER LOADING CURING CHAMBER | 11 | 6.5 | 21.6 | 1.0 | 66.3 | 4.5 |
| | 13 | 1.9 | 26.8 | 1.8 | 64.3 | 5.2 |
| | 14 | 4 | 29.0 | 2.5 | 56.9 | 7.6 |
| | 15 | 0 | 29.6 | 1.9 | 62.6 | 5.8 |
| | 16 | 3.9 | 24.8 | 1.9 | 63.7 | 5.7 |
| | AVG | 4.1 | 26.4 | 1.8 | 62.8 | 5.8 |
| 18 HOURS AFTER LOADING CURING CHAMBER | 19 | 5.6 | 21.9 | 2.8 | 66.1 | 3.7 |
| | 20 | 5.3 | 22.3 | 3.4 | 64.3 | 4.3 |
| | 22 | 6.1 | 24.8 | 0.9 | 64.7 | 3.4 |
| | | 3.7 | 25.1 | 2.3 | 68.9 | 0.0 |
| | AVG | 5.7 | 23.53 | 2.35 | 66.0 | 2.9 |
| 24 HOURS AFTER LOADING CURING CHAMBER | 25 | 1.3 | 24.5 | 0.8 | 69.9 | 3.5 |
| | 26 | 1.5 | 25.5 | 0 | 69.3 | 3.6 |
| | 27 | 2.6 | 28 | 1.1 | 61.8 | 6.5 |
| | 28 | 2.9 | 25.8 | 0 | 67.4 | 3.8 |
| | AVG | 2.075 | 25.95 | 0.475 | 67.1 | 4.35 |
| END OF CURE | 33 | 0 | 27.3 | 2.5 | 67.2 | 3 |
| | 34 | 3 | 28.4 | 1.3 | 64 | 3.2 |
| | 35 | 0.6 | 27.6 | 0 | 68.6 | 3.2 |
| | 36 | 0.6 | 26 | 3.1 | 64 | 6.2 |
| | AVG | 1.05 | 27.325 | 1.725 | 65.95 | 3.9 |